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The Ohio State University Bulletin

Announcements of the Department of Zoology and Entomology

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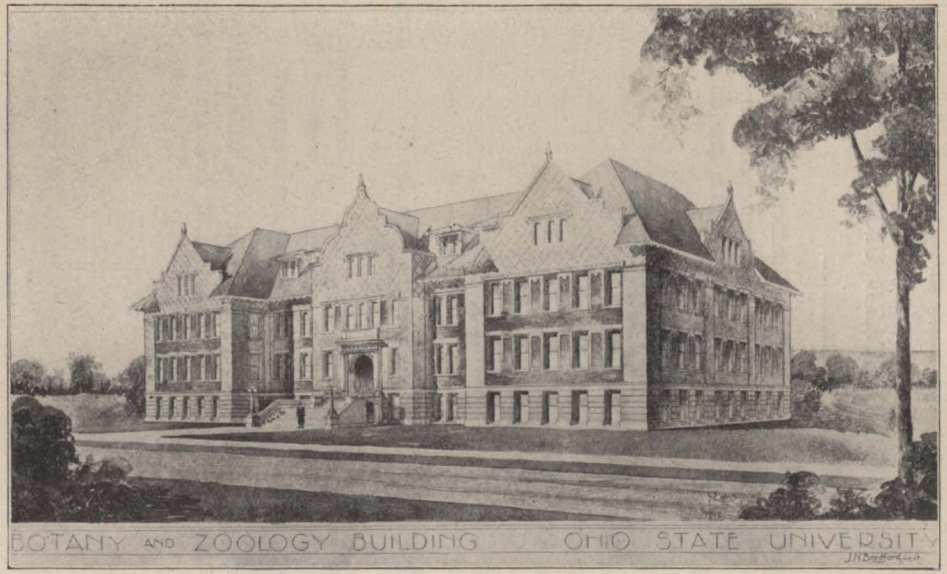
THE OHIO STATE UNIVERSITY

The Ohio State University, located at Columbus, is a part of the public educational system maintained by the State. It comprises seven colleges and a graduate school:

The College of Agriculture.
The College of Arts, Philosophy, and Science.
The College of Education.
The College of Engineering.
The College of Law.
The College of Pharmacy.
The College of Veterinary Medicine.
The Graduate School.

The University publishes a bulletin describing the work of each of these colleges. Copies may be obtained by addressing W. E. Mann, University Editor, Columbus, Ohio. Persons desiring information are invited to send for the bulletin of that college in which they are interested.

This bulletin is devoted exclusively to a description of the work offered by the Department of Zoology and Entomology.



NEW BOTANY AND ZOOLOGY BUILDING
THE FUTURE HOME OF THE DEPARTMENT
[From Architect's Perspective]

Historical Sketch

The Department of Zoology and Entomology of the Ohio State University was organized in 1874, and Professor Albert H. Tuttle, now Professor of Biology in the University of Virginia, was the first Professor in charge, with the title of Professor of Zoology and Comparative Anatomy. He resigned in 1888 and Dr. D. S. Kellicott was elected to the Chair. Dr. Kellicott served until his death in 1898 and the present head of the Department took charge in September of the same year.

The Department was first housed in University Hall, but in 1898 it occupied the present Biological Hall in conjunction with the Department of Anatomy and Physiology. This building was soon overcrowded and for several years the department has had temporary quarters for a portion of its work in the basement of Page Hall. Efforts to secure necessary room adapted to the department work have now resulted in the provision for a new building to accommodate the departments of Botany, and Zoology and Entomology. The construction of this new building is now under way and it is expected to be ready for use by the department at the beginning of the fall semester in 1914.

Staff of Instruction

WILLIAM OXLEY THOMPSON, D. D., LL. D.,
PRESIDENT OF THE UNIVERSITY

HERBERT OSBORN, M. Sc., ... *Professor*
Entomology, Invertebrate Zoology

F. L. LANDACRE, A. B., ... *Professor*
Comparative Anatomy, Embryology, Neurology

JAS. S. HINE, B. Sc., ... *Associate Professor*
Entomology, Ornithology

WM. M. BARROWS, S. M., ... *Assistant Professor*
Experimental Zoology

W. J. KOSTIR, A. M., ... *Instructor*

C. J. DRAKE
MARY B. HOWE
MARGUERITE ICKES
F. H. LATHROP — *Fellows*
EVELYN OSBORN
WALTER A. PRICE
A. R. SHADLE

Purposes of the Courses in this Department

The object of the work in this Department is to furnish a general raining for those who wish to study the subject as a part of their general culture; as a basis for understanding the various phases of the development of life, the problems of evolution and the basis of the social sciences; for the preparatory work necessary in the study of medicine; for the training in the underlying sciences of Agriculture and Horticulture, and also to provide special advanced work as a preparation for research in Zoology and Entomology or for teaching or other professional work in these special lines. A special four year course in applied Entomology is designed to train particularly for such technical work.

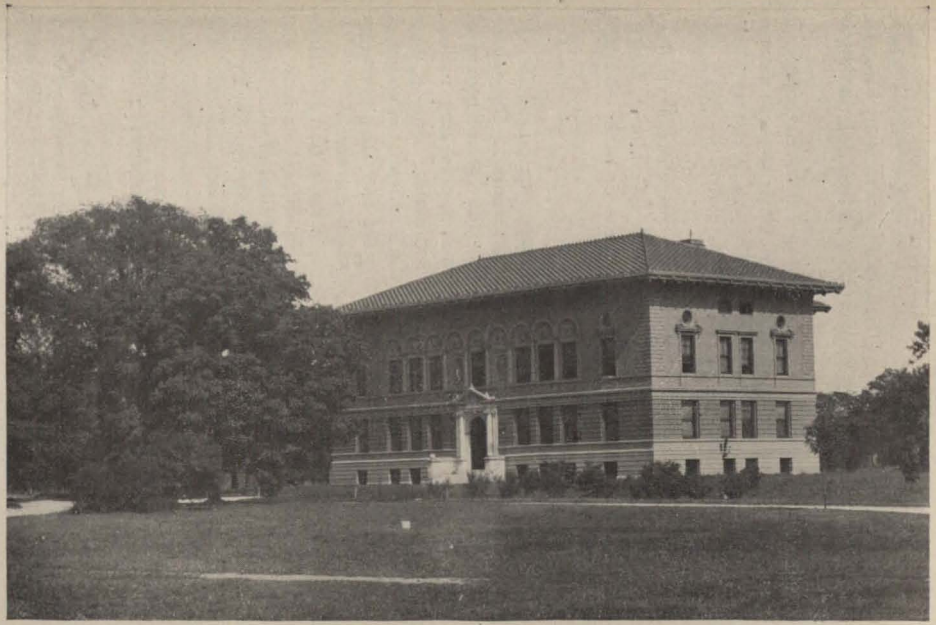
The work may be pursued in the College of Agriculture, the College of Arts, Philosophy and Science, or in the College of Education, the various bachelor degrees or advanced degrees that may be obtained in these various colleges being open for those who have taken special work in this department, while the degree of Bachelor of Science in Entomology is open to graduates of the four year course in applied Entomology.

Opportunities for Graduates in Special Lines of Zoology and Entomology

There are at the present time many different openings for persons trained in these branches, the demand for work of this sort being much greater at present than at any time in the past, and many of the positions offered are such as give excellent compensation and offer very desirable opportunities for advancement. A brief enumeration of these various lines may assist the student in securing, in advance, the kind of work he might find of greatest service in the particular field he may wish to enter.

(1) Work as research assistants or investigators in the Bureau of Entomology. These positions have a very permanent character, give opportunity for investigation in various parts of the country, and have exceptional facilities for work in Washington.

(2) Positions as entomologists in the State Experiment Stations. These positions offer a high degree of permanency and opportunity for thoroughly well trained men, and are particularly attractive on account of the opportunities for carrying on research work. Connected with these, in some instances, and under separate control in other cases, are the positions open to inspectors in the various states. These



BIOLOGICAL HALL

THE PRESENT HOME OF THE DEPARTMENT

require usually less acquaintance with the subject in general, but special training in the matter of recognition of the species under inspection.

(3) Teachers in Agricultural Colleges or other schools where these subjects are given attention. These positions in many cases are of a high grade and offer not only opportunity in teaching, but more or less of opportunity for investigation.

(4) Aside from these there are occasional attractive openings in the Bureau of Fisheries, which appeal particularly to those who are interested in aquatic life, and positions in the Biological Survey which give opportunity more particularly for investigation of birds and mammals.

(5) There are also occasional openings to specialists, as curators in museums, or as state investigators in research laboratories, and in such establishments as the Carnegie Institution or other endowed organizations.

Department Facilities

The staff of instructors and the laboratory equipment for the department are sufficient to provide very complete courses. The department has extensive collections, especially for the various groups of insects, the number of specimens at present approaching 100,000. The collections include some quite important series. Among these are the Tallant Collection of Lepidoptera, the Kellicott Collection of Odonata, and the special collections in Diptera and Hemiptera that have been brought together by members of the department.

The University Library includes extensive series of publications from the government bureaus, the various experiment stations, and the usual serial publications as well as a large number of volumes specially selected for the department needs. A department library, the nucleus of which was the private library of Professor Kellicott, and donated at the time of his death, has grown by the addition of many papers from specialists and by the exchange of department contributions. This has been designated the KELLICOTT MEMORIAL IN THE DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY.

Aside from the facilities offered at the University, the University maintains a Lake Laboratory at Cedar Point near Sandusky, where special advanced courses relating particularly to the life of the locality are offered with a competent staff of teachers. These give exceptional opportunity for experience in field work and practise in the methods of investigation under actual field conditions.

The Lake Laboratory work is described in brief in the latter part of this bulletin.

COURSE IN APPLIED ENTOMOLOGY

Degree: Bachelor of Science in Entomology

FIRST YEAR

First Semester			Second Semester		
Zoology	(101)	3	Zoology	(102)	3
Chemistry	(105 or 109)	4	Chemistry	(106 or 110)	4
Modern Language	(101)	4	Modern Language	(102)	4
French—Spanish—German			French—Spanish—German		
English	(101)	2	English	(104)	2
Drawing	(135)	2	Drawing	(136)	2
Meteorology	(101)	2	Botany	(110)	2
Cadet Service		1	Cadet Service		1
Gymnasium		1	Gymnasium		1

SECOND YEAR

Zoology	(107)	3	Zoology	(108)	3
Entomology			Entomology		
Botany	(101)	4	Botany	(102)	4
Modern Language	(103)	4	Modern Language	(104)	4
French—Spanish—German			French—Spanish—German		
Horticulture	(101)	4	Horticulture	(102)	4
Chemistry of Insecticides (?)		2	Geology	(152)	3
Bibliography	(103)	½	Cadet Service		1
Cadet Service		1			

THIRD YEAR

Entomology	(113)	4	Entomology	(114)	4
Entomology	(153)	2	Botany	(116)	3
Agronomy	(106)	4	Agronomy	(111)	3
Bacteriology	(107)	4	Bacteriology	(108)	4
Elective		2-3	Photography	(111)	2
			Elective		2-3

FOURTH YEAR

Entomology—Medical	(149)	3	Apiculture	(112)	
Entomological Literature	(147)	2	or Forest Entomology	(150)	3
Entomology—Legislation			Entomology—Taxonomy	(148)	2
Inspection, Quarantine	(151)	3	Entomology	(152)	3
American History	(101)		Insecticides, Insecticide machinery and insect control		
or Economics	(135)	3	American History	(102)	3
Elective		5-6	or Economics	(136)	
			Elective		6-7

Note: Unless the candidate for a degree has had a full equivalent, not less than one summer of field work in an Experiment Station, or other practical work in Entomology is required before graduation.

Courses of Study

101-102. ELEMENTARY ZOOLOGY. Three credit hours. First semester, invertebrates to the arthropods. Second semester, arthropods and vertebrates. MR. OSBORN, MR. LANDACRE, MR. BARROWS MR. KOSTIR and Assistants.

This course includes a general discussion of groups, dissection of types, and an outline of classification. Especial attention is given to forms of economic importance either from their detrimental effects on crops, stock, etc.; their relation to disease; or from their utility in various industries, or as domestic species.

The work of the first year in Zoology requires perhaps a somewhat fuller statement with regard to its relation to other studies and to general education. It aims, as a matter of course, to give such knowledge of fundamental principles concerning animal life and the activities of living things as to furnish a basis for more advanced work in Animal Husbandry, Physiology, or special Zoological subjects. Its place as a preparation for medical studies is generally appreciated. It is perhaps less recognized that it comes in as an important part of a course in general culture: Further, such a course as this may be of special service in giving a foundation for a comprehension of the increasing current literature relating to animal life and to the relations of animals to mankind. This particular course however, attempts to accomplish more than a preparation for further work in Zoology or serve as a discipline, as it is the only opportunity for many to obtain an insight into the processes of living matter. It is its purpose to give a survey of the activities of living things, so that they may be appreciated in their bearing upon other fields of knowledge. It offers an insight into the social relations among lower animals and particularly the social conditions established among those species that form communities, and are thus subject to the same laws of social life that are represented in the development of human society. For the student of psychology it shows in the behavior of animals the primitive activities which are traced into the intellectual activities of man, and for the students of philosophy it furnishes the basis for an understanding of those evolutionary processes which now constitute so large a foundation in philosophic studies. To the student of human history, the succession and distribution of life in all ages is found to furnish a clue to the migrations of mankind and the development and decline of races or nations. Even in the study of language or philology there is deeper meaning, if it be realized, that language as an expression or means of communication among individuals is a development which had its roots far back among the lower forms of animal life. The course is

offered and taught with the hope of meeting these apparently diverse but essentially similar needs.

It is required in the College of Agriculture, is elective in Arts, Philosophy and Science and Education, and is considered a desirable antecedent to the courses in Sociology, Psychology, and Philosophy.

103. COMPARATIVE ANATOMY OF THE VERTEBRATES: VERTEBRATES TO BIRDS. Three to five credit hours. First semester. Prerequisite, course 101-102, or equivalent. MR. LANDACRE.

104. COMPARATIVE ANATOMY OF VERTEBRATES: BIRDS AND MAMMALS. Three to five credit hours. Second semester. Prerequisite, course 101-102, or equivalent. MR. LANDACRE.

These courses are intended to meet the requirements for preparation for Medicine and to furnish a thorough foundation for advanced work in Embryology or for the teaching of general Zoology.

107-108. ECONOMIC ENTOMOLOGY. Three credit hours. The year. Prerequisite, course 101-102. MR. OSBORN, MR. HINE.

A systematic study of groups of insects, with special reference to injurious and beneficial species. A foundation is laid for special study in Entomology. Preparation of collections, essays, life studies, and use of remedial measures, along with laboratory studies on general anatomy. Required in College of Agriculture, Elective in College of Arts, Philosophy and Science.

109-110. SYSTEMATIC AND PRACTICAL ENTOMOLOGY. Three credit hours. The year. Elective in short course in Agriculture. Required in short course in Horticulture. MR. HINE.

111. PARASITES OF DOMESTIC ANIMALS. One credit hour. First semester. Elective. MR. OSBORN.

A lecture course devoted to the principal parasites affecting domestic animals, intended especially to meet the needs of those who intend to give particular attention to stock raising.

112. APICULTURE. Three credit hours. Second semester. Elective. MR. HINE.

A study of the honey bee and the principles of bee-keeping, with practical training in the handling of bees.

113-114. SPECIAL ENTOMOLOGY. Four credit hours. The year. Elective in Junior or Senior year in College of Agriculture. MR. OSBORN.

Field work and lectures. Studies of structure, life histories, collection, and classification in selected groups, winter condition of

insects, insecticides, insecticide machinery, methods of preparing insect illustrations, investigations of selected groups or species, greenhouse pests, etc. Lectures on insect legislation, inspection, quarantine, distribution, natural enemies, special method of control, etc.

Courses 113 and 114 are intended as practical courses in entomological research, adapted especially for those who wish to give special attention to this branch with reference to future work in agriculture or horticulture, and to furnish a preparation for those who have in view work as entomological investigators in experiment stations or as teachers in agricultural schools. They may be taken as graduate courses if not elected earlier, or continued as special lines of research during a graduate course embracing other special subjects.

119. GROSS ANATOMY OF THE FROG. Three to five credit hours. First semester. Prerequisite, course 101-102 or equivalent. MR. LANDACRE.

120. EMBRYOLOGY OF THE FROG. Three to five credit hours. Second semester. Prerequisite, course 101-102 or 119. MR. LANDACRE.

121-122. INVERTEBRATE MORPHOLOGY. Three to five credit hours. The year. Prerequisite, course 101-102. MR. OSBORN.

This course serves to extend the student's acquaintance with invertebrate animals to furnish the morphological foundations for an understanding of classification and is especially serviceable as a basis for special study in entomology.

125. VERTEBRATE EMBRYOLOGY, KARYOKINESIS, AND THE EARLY DEVELOPMENT OF AMPHIOXIS, FISHES, AND AMPHIBIANS. Three to five credit hours. First semester. Prerequisite, course 101-102. Lecture and laboratory. MR. LANDACRE.

126. VERTEBRATE EMBRYOLOGY: BIRDS AND MAMMALS. Three to five credit hours. Second semester. Prerequisite, course 101-102. Lecture and laboratory. MR. LANDACRE.

128. EMBRYOLOGY: Two credit hours. Second semester. Required in Veterinary course. MR. LANDACRE.

147. ENTOMOLOGICAL LITERATURE. Two credit hours. First semester. Prerequisite, Zoology. 101-2, 107-8. MR. OSBORN.

Lectures on the development of entomological writings, studies of Government and Experiment Station Bulletins and other publications, assigned readings and preparation by each student of report or review upon some publication. Intended to familiarize the student with past and current publications and give him command of the published records in his field of study.

148. ENTOMOLOGY—TAXONOMY. Two credit hours. Second semester. Prerequisite, Zoology. 101-2, 107-8. MR. OSBORN, MR. HINE.

A study of the principles of classification with lectures on Taxonomic systems, codes of nomenclature, etc. Practical work in the classification of selected group or groups of insects.

149. MEDICAL ENTOMOLOGY. Three credit hours. First semester. Prerequisite, Zoology. 101-2, 107-8 or equivalents.

Lectures demonstrations and recitations upon the insects concerned in production and transmission of diseases of man or domestic animals, parasitism–relation to pathogenic bacteria and protozoa, sanitation, and health. Intended to give a general survey of the subject but adapted also for students who expect to enter the medical or veterinary profession or who wish to prepare as teachers or investigators in Medical Zoology.

150. FOREST ENTOMOLOGY. Three credit hours. Second semester. Prerequisite one year of Entomology.

Lectures, reading, field work and preparation of collections covering in detail the insects affecting Forest, Shade and Ornamental trees. Especially designed for forestry students who wish to do advanced work in entomology but open to all students properly prepared who are interested in forest insects.

151-152. ENTOMOLOGY. Insect control. Three credit hours. First and second semester. Prerequisite, Zoology. 101-2, 107-8, 113-14 or equivalent.

Technical studies of Insect control, utilization of Parasitic or Predaceous forms. Legislation, Quarantine, Inspection, Insecticides, Insecticide machinery and practical work in fumigation, spraying, etc.

153. INSECT BEHAVIOR. Two credit hours. First semester. Prerequisite Zoology. 101-2, 107-8.

A study of the behavior and reaction of insects and related animals with special reference to their connection with insect control. MR. BARROWS.

155-156. ENTOMOLOGY. Three credit hours. The year. Required in the course in Forestry.

An elementary course dealing with structure and habits of insects with especial reference to the forms that are of importance to Forestry. MR. HINE.

FOR ADVANCED UNDERGRADUATES AND GRADUATES

129-130. QUANTITATIVE STUDIES IN VARIATION, HEREDITY, AND ANIMAL BEHAVIOR. The year. Critical studies of variation and

heredity, including discussions of the categories of variations, origins of variations, mendelian and non mendelian inheritance, effects of selection, cross-breeding and inbreeding, statistical and pure line methods of analysis of data. Elective. Prerequisite, Zoology 101-102. The course can be adapted to the particular needs of the student. MR. BARROWS.

131-132. EVOLUTION. Three credit hours. The year. Prerequisite, one year of Zoology or an equivalent. MR. OSBORN, MR. LANDACRE.

A discussion of the facts and theories of the origin, development, and distribution of animal life. The first semester deals chiefly with variation, isolation, and heredity as the fundamental factors in the Evolution of Animal forms. The second semester is devoted to geographical distribution, adaptations, and the application of the laws of heredity to practical problems.

133. COMPARATIVE NEUROLOGY. Three to five credit hours. First semester. The origin and structure of the nervous system of the lower vertebrates. MR. LANDACRE.

134. COMPARATIVE NEUROLOGY. Three to five credit hours. Second semester. The origin and structure of the nervous system of the higher vertebrates. MR. LANDACRE.

A large amount of illustrative material is available for this course and there is an excellent opportunity to carry it forward in orginal investigations.

135-136. CYTOLOGY. Three to five credit hours. The year. Prerequisite, course 101-2, 103-4, or 121-2. MR. LANDACRE.

A study of the cell as an organism and as a factor in development and inheritance.

137-138. ADVANCED ENTOMOLOGY. Three to five credit hours. The year. Prerequisite, course 101-102, 107-108. Elective in College of Arts, Philosophy and Science. MR. OSBORN.

An advanced practical course dealing with morphology, development, biologic relations and principles of classification, for those wishing to investigate some special groups of insects or to fit themselves for professional work in Entomology. Lectures, laboratory, and field work.

139. ORNITHOLOGY. Two credit hours. First semester. Lecture and laboratory. The first semester is devoted to the anatomy of the birds and to the study of museum specimens. MR. HINE.

140. ORNITHOLOGY. Two credit hours. Second semester. Lec-

ture and laboratory. This semester is devoted to systematic field work. MR. HINE.

141-142. RESEARCH WORK. Subject to be assigned. Five to ten credit hours. The year. Prerequisite, course 101-102, and the equivalent of 103-104, or 121-122, or 125-126. MR. OSBORN, MR. LANDACRE.

143-144. ZOOLOGICAL SEMINAR. One credit hour. The year. MR. OSBORN, MR. LANDACRE, MR. HINE.

Discussion of recent literature in Zoology and Entomology, reviews of progress in certain lines of investigation and presentation of research studies. Advanced students in Zoology and Entomology are expected to elect this course, and it is open to others who have had preliminary courses.

145-146. TEACHERS' COURSE. Two or three credit hours. The year. Prerequisite, Zoology 101-102. MR. OSBORN, MR. LANDACRE.

This course is offered with the object of familiarizing the student with the material and the method of handling laboratory courses in Zoology with actual practise in the supervision of laboratory students.

FOR GRADUATES

223-224. INVERTEBRATE EMBRYOLOGY. Three to five hours. The year. Korscheldt and Heider used as a basis. Lecture and laboratory. MR. OSBORN.

241-242. RESEARCH WORK. Subject to be assigned. Five to ten hours. The year.

Research problems in development, life history, morphology or taxonomy may be undertaken. For some of these, the opportunities are particularly good at the Lake Laboratory. MR. OSBORN, MR. LANDACRE.

247-248. INVERTEBRATE ZOOLOGY. Five hours. The year. MR. OSBORN.

249-250. VERTEBRATE EMBRYOLOGY. Three to five hours. The year. MR. LANDACRE.

Suggested Courses.

Students who intend to enter the medical profession should take General Zoology 101-2 during the first year, if possible, and follow this with Comparative Anatomy 103-4, Embryology, and then a selec-

tion may be made between Invertebrate Morphology, Medical Entomology, Animal Parasites, or some other course bearing upon medical Zoology.

Students desiring to prepare especially for work in the government service or experiment stations should begin with the General Zoology 101-2, and follow this with Entomology, Invertebrate Morphology, Embryology, Experimental Zoology and a research course. They should have Physiology, Botany, Geology and Bacteriology, as associated courses, and should take German and French as early in the course as possible. If desiring to complete such a course in four years the new four-year course in Applied Entomology is recommended.

Those intending to enter the teaching profession should take Zoology 101-2, and follow this with Comparative Anatomy, Invertebrate Morphology, Entomology, Embryology, or the teacher's course and arrange to do some practise work in the laboratory. A number of students have offered their services as volunteer assistants and are thus securing a valuable experience in handling laboratory work.

Graduate Work

Graduates of this Institution or of other colleges can carry on graduate courses including some of the courses mentioned above, or special research courses with the work arranged for each student. The general outline of these courses is briefly stated in the preceding summary:

Students entering upon graduate work in this department are expected to be familiar with the elements of chemistry, physics, and botany; to have a reading knowledge of French and German and to have had at least two years' work in Zoology, the equivalent of Zoology 101-2 (General Zoology) and Zoology 103-104 (Comparative Anatomy of Vertebrates). The department can offer good facilities in Embryology, Neurology, and various phases of entomological work.

Fellowships

To encourage graduate work, the department has, for a number of years, offered several fellowships of $300 each with remission of fees, to qualified graduate students who are required to give not more than half time to assistance in the laboratories. This assistance, especially for those who are preparing to teach, gives an excellent experience in laboratory methods.

For information as to fellowships, address the Dean of the Graduate School or the Head of this Department.

Publications

The department is prepared to assist advanced students in the matter of publication of research work of merit, either through the Ohio Naturalist, which is the official organ of the Biological Club and the Ohio Academy of Science, or in various technical journals. A series of "Contributions," now numbering thirty-four and representing the more extended studies of the department by faculty or students, is maintained and consists of reprints from the various scientific journals in which articles have appeared.

LAKE LABORATORY

The Lake Laboratory of the Ohio State University, located on Cedar Point near Sandusky, is designed to provide a meeting ground for teachers and students of biology, to afford opportunity for the investigation of the biology of the lake region, and for giving certain courses of instruction in biological subjects.

The instructors are selected, in a large part, from the various colleges within the State and the policy is to secure from year to year as full a representation as possible of the biological workers of the different institutions.

Staff of Officers and Instructors for 1914

WILLIAM OXLEY THOMPSON, D. D. LL. D.,
PRESIDENT OF THE UNIVERSITY

*HERBERT OSBORN, M. Sc., DIRECTOR . . . . . .
Professor of Zoology and Entomology

CHARLES BROOKOVER, B. Ped., Ph. D., ACTING DIRECTOR 1914 .
Ichthyology, Embryology
Professor of Histology and Embryology, University of Arkansas

STEPHEN R. WILLIAMS, Ph. D., ...
Comparative Anatomy, Invertebrate Morphology
Professor of Zoology, Miami University

EDWARD L. FULLMER, M. Sc. . . . . Botany, Ecology
Professor of Biology, Baldwin-Wallace University.

CHARLES G. SHATZER, A. M., . . Ornithology, General Zoology
Professor of Biology and Geology, Wittenberg College

W. J. KOSTIR . . . . . Entomology
Instructor in Zoology and Entomology, Ohio State University

Location.

The Laboratory has a beautiful site on Cedar Point, located close to the waters of Lake Erie and Sandusky Bay which teem with animal and plant life. Extensive marshes, the river, native forest, sandy beach, and rocky islands are all within easy reach and furnish opportunities for study of life under greatly varied conditions. Put-in-Bay with the United States Fish Hatchery, Kelly's Island with its famous glacial grooves, and other points of great natural interest are easily reached by excursions and are visited in collecting or special trips. The extensive fishing industry centering at Sandusky affords special opportunity for study and investigation in Ichthyology.

Facilities

A commodious laboratory building, capable of accommodating at least one hundred students and investigators, gives excellent accommodations for the work. It is provided with tables, dark rooms, aquaria, water and gas. Microscopes and other apparatus are supplied from the University.

Boats, collecting apparatus, dredges, seines, etc., are furnished and special attention will be given to the methods of collecting and field work.

*Absent on leave summer 1914.

NOTE.—A special, bulletin, describing fully the work to be offered at the Lake Laboratory in 1914, is published by the University. Requests for this bulletin should be addressed to W. E. Mann, University Editor, Columbus, Ohio.

Courses of Study in Zoology and Entomology as offered for the Session of 1914

*a. GENERAL ZOOLOGY: Especially for Teachers. Laboratory and field courses with occasional lectures and quiz, and including dissection or microscopic study of type forms, aquaria, and field studies with instruction in collecting and preparing material for laboratory use and permanent collections.

b. EMBRYOLOGY. A study of mitosis, segmentation, and germ layer formations of different types, but with special emphasis on the development of the fish. The course will be offered as far as possible from material collected at the Laboratory. Students properly qualified may undertake the study of some embryological problem. MR. BROOKOVER.

c. ENTOMOLOGY. Field and laboratory course, including instruction in collecting, mounting and identifying insects in connection with studies in life history and anatomy. Excellent opportunities for life-history studies are offered both on aquatic and terrestrial forms. MR. KOSTIR.

d. ICHTHYOLOGY. Special course devoted particularly to the lake fishes, their habits and food supplies. MR. BROOKOVER.

e. ORNITHOLOGY. Field work, together with lectures on morphology and natural history of birds. In the field work especial attention will be devoted to the study of the shore, swamp, and water birds, breeding habits, and the ecological conditions of the vicinity of the laboratory. MR. SHATZER.

f. INVERTEBRATE MORPHOLOGY. An advanced course including laboratory work on representative forms, investigations of special morphological problems, and a discussion of the classification and phylogenic relationship of the various groups of invertebrates, with occasional lectures and quizzes. MR. WILLIAMS.

*g. EXPERIMENTAL ZOOLOGY. Lecture and laboratory course. A review of the methods and results of the experimental study of zoology and evolution, with special reference to later work on variation and heredity. A study of Mendel's Law will be undertaken with its application to animal breeding from both the practical and theoretical viewpoint. The laboratory work will consist in the experimental study of certain animals of the region with relation to their variation, environment, breeding habits and growth, including a study of the tropisms. Open to those who have had a course in general zoology.

*Not offered in 1914.

*h. VERTEBRATE COMPARATIVE ANATOMY. Lectures and laboratory work. In view of the shortness of the session a rather small number of types will be dissected in the laboratory, and the attention will be concentrated on certain selected organs and systems of organs. The work may be varied to suit individual requirements.

i. RESEARCH WORK. Students who desire, if properly qualified, may enter upon some faunal, ecological, or other problem, under the direction of some one of the professors present.

j. AQUATIC BIOLOGY. This course will deal primarily with the fresh water forms of life occurring in Sandusky Bay, paying particular attention to the micro-organisms.

After obtaining a general knowledge of the representatives of the various classes of organisms, each student will select one form and study it as exhaustively as time permits. Plankton and Plankton methods will receive due consideration. Throughout the course attention will be paid to the technique of collecting and preparing material. It is desirable, although not absolutely necsssary, that students taking the course possess a reading knowledge of German and and French. Occasional letters and quizzes. MR. WILLIAMS.

University Credit

It will be noticed that several of the advanced courses cover the ground of university courses. Students with university standings may secure credit for such work. The opportunities for research or thesis work are also exceptionally good in certain lines. Credit at the University will be given on the following basis: One lecture each day and four hours laboratory work, including the work laid out for Saturday, will give a student credit for six semester hours. When arrangements are made for continuing the work for two additional weeks, nine semester hours credit can be secured.

The Ohio State University Bulletin is issued at least twenty times during the year; monthly in July, August, September and June, and bi-weekly in October, November, December, January, April and, February, March, May.

*Not offered in 1914.